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Supplying Energy for Milk Production

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The first requirement, under most conditions, for an economical dairy feeding program is to provide the milking herd all the top quality forage it will eat. Most harvested forages in South Dakota supply only enough energy for body maintenance and about 10 to 20 pounds of milk per cow per day without additional grain, therefore, feeding grains and concentrates is necessary to obtain maximum milk production. Normally, as forage quality decreases consumption decreases, and milk production is reduced unless the cow receives additional energy from a grain ration.

The dairy ration must be palatable and contain a liberal supply of energy, sufficient protein and fat, and an adequate supply of minerals and vitamins. The greatest needs of the dairy cow are protein and energy. Providing enough energy to get high producing cows to produce to their genetic potential is usually the major nutritional problem on most dairy farms. It is essential to provide enough energy along with protein because when energy intake is deficient, some of the protein fed is used to provide energy. Protein is a more expensive source of energy than are farm grains.

Net Energy or TDN

Before discussing energy needs and grain feeding guidelines, it is essential to discuss the terms used to measure energy. The most often used terms to describe energy are total digestible nutrients (TDN) and net energy (NE). Although derived differently, either of these terms may be used to determine the cow's energy requirements and to express the energy value of feedstuffs.

Net energy measures the actual energy available for production and is commonly expressed in megacalories or therms. One of the major advantages of NE over TDN is that it is more accurate in measuring the energy value of forages. The TDN system tends to over estimate the nutritive value of most forages. Usually, the energy values of concentrates and grains are quite similar for the two systems.

For most practical purposes either TDN or NE may be used. The main precaution in the use of either term is to use only one system in determining the cow's requirements and the value of feeds being fed. Net energy will be used in this discussion because under the Dairy Herd Improvement Association (DHIA) program, the individual needs of the cow and nutrients provided by the various feeds are expressed in this manner.

ENERGY NEEDS OF THE COW

The total ration must supply sufficient energy for the cow's body maintenance, growth, reproduction, and milk production.

Body Maintenance

Body maintenance takes first priority on the use of energy. The larger the cow, the greater is the need of energy for maintenance (table 1).

Table 1. Daily energy needs for maintenance*

Body weight	Net energy
Pounds	Therms
800	6.9
1000	8.3
1200	9.5
1400	10.7
1600	11.8

*Nutrient Requirements of Dairy Cattle, National Research Council, 1971.

Growth

Growth allowances for energy in addition to maintenance are required during the first two lactations. About 20% needs to be added to the maintenance allowance during the first lactation and 10% during the second lactation to meet the energy requirements for growth. For example, if a first calf heifer weighs 1,200 pounds, she would have a maintenance requirement of 9.5 therms of net energy (table 1). To meet her needs for growth, she needs an additional 20% more energy, or 1.9 therms (9.5 x .20 =1.9) additional energy. Thus, she has a daily energy requirement of 11.4 therms for maintenance and growth (9.5+1.9=11.4).

Reproduction

During the last two or three months of pregnancy, additional energy should be fed because about two-thirds of the weight of the unborn calf is made during this time. The energy needs for maintenance and pregnancy are presented in table 2.

Table 2. Daily energy needs for maintenance and pregnancy.*

Body weight	Net energy
Pounds	Therms
800	8.8
1000	10.8
1200	12.5
1400	14.1
1600	15.7

*Add 20% to these requirements for first calf heifers and 10% for second calf heifers.

Milk Production

Milk production requirements for energy depend upon both the amount of milk produced and its fat content (table 3). Multiply the appropriate factor times the pounds of milk.

Table 3. Daily energy needs for milk production.

Milkfat	Net energy
%	therms per lb. of mlk
3.0	.290
3.5	.314
4.0	.336
4.5	.354
5.0	.377
5.5	.400

Total Energy Requirements

To determine the total energy needs of a cow, all requirements are added together. For example, the energy requirements of a mature non-pregnant cow weighing 1,400 pounds and producing 60 pounds of 3.5 percent milk are presented in table 4.

Table 4. Maintenance and milk production energy requirements.

Requirement	Net energy
	therms
Maintenance, 1,400 lb.	10.7
Milk production, 60 lb./day at 3.5% fat 60 lb. x .314	18.8
Total daily energy requirement	29.5

Use of Feeding Standards

Although feeding standards and requirements are accurate and are especially helpful in showing the deficiencies of a herd ration, they should be used primarily as a guide because the needs of individual cows vary and depend upon environmental conditions, activity of the animal, and other factors. They indicate the approximate needs of the cow and act as guides for meeting her requirements. Most dairymen do not go through the tedious task of balancing their ration each time they change forages or grains. Guidelines have been developed to assist the dairyman in determining the amount of energy needed from a grain ration.

The average NE content of feedstuffs common to South Dakota dairymen is presented in table 5. The energy content will vary between the kind and quality of forage. For example, corn silage on a 90% air dry basis contains .66 therms of NE per pound compared to alfalfa which contains .44 to .50 therms per pound.

Table 6 lists general guidelines for the amount of grain to feed with average quality forages. Dairymen should adjust list to compensate for poor quality forage or to take advantage of good forage.

Table 5. Average composition of feeds for net energy.

	Dry matter %	Net energy
	As fed	Therms per lb.
DRY FORAGES:		
Alfalfa hay		
Early bloom	90	0.50
Mid-bloom	90	0.46
Full bloom	90	0.42
Alfalfa-brome hay		
Early cut	90	0.50
Late cut	90	0.46
Red clover hay		
Early cut	90	0.50
Late cut	90	0.46
Prairie hay	90	0.40
SILAGES:		
Alfalfa, wilted		
Early bloom	45	0.25
Mid-bloom	45	0.24
Full bloom	45	0.22
Corn	30	0.22
Oats, wilted		
Boot	45	0.24
Milk	45	0.23
Early dough	45	0.20
Sorghum	30	0.19
GRAINS AND CONCENTRATES:		
Barley	90	0.80
Corn and cob meal	90	0.75
Corn, shelled	90	0.80
Linseed meal	90	0.85
Milo	90	0.78
Oats	90	0.73
Soybean meal	90	0.85
Soybeans	90	0.90
Wheat	90	0.80

Table 6. Recommended grain feeding rate for different milk production levels.

Breed	Milk production per day (lb.)	lb. grain per lb. milk
Holstein, Brown Swiss	less than 10	none
Ayrshire	10-30	1:4.0
	30-60	1:3.0
	60+	1:2.5
Jersey, Guernsey	less than 10	none
	10-30	1:3.0
	30-60	1:2.5
	60+	1:2.0

Following these grain feeding guidelines, and feeding forage free choice, a dairyman should satisfy the energy needs of the majority of his cows. With extremely high producing cows, particularly in early lactation, extra grain should be fed to challenge the cows to higher production. In order for the high producing cow to consume the allotted grain ration, the amount of forage fed may need to be reduced. There is a limit to the amount of forage that can be replaced with the grain ration. The forage fed should never be lower than one pound of air dry forage per hundred pounds of body weight, or milk fat tests may drop to extremely low levels.

Grain Feeding Methods

The traditional method of feeding dairy cows has been to offer forages free choice and feed the grain ration individually. With the shift from individual handling toward group handling (free stalls) it is no longer possible to feed cows individually. Many cows do not have time to eat the grain ration they need during the time they spend in the milking parlor. The average length of time that cows are in the parlor under South Dakota conditions ranges from 8 to 12 minutes per milking. With the average grain consumption rate of a cow about .6 to .8 pounds per minute, the average cow can only consume from 6 to 10 pounds per milking, or a maximum of 16 to 20 pounds of grain per day. Coarsely ground grains (5/16 inch screen) will be consumed faster than a finely ground grain. High producing cows will be energy deficient under these feeding conditions.

A solution to this problem is to group feed the grain ration outside the parlor. A common method of feeding is to mix grain with forage and feed the total ration as a complete feed. Ideally, dividing the herd into three production groups, (high, medium, and low) would allow a dairyman to feed more closely to each cow's needs. For example, if a dairyman had a group of 20 high producing cows averaging 75 pounds of milk per cow per day, each cow should be fed 30 pounds of grain ration daily (1 lb. grain per 2.5 lbs. milk=30). A total of 600 pounds of grain (20 cows x 30 lbs.=600) would need to be fed to the group each day.

Dairymen who do not have the facilities to group cows according to production groups, may consider feeding a basal level of grain to the entire herd and feeding the higher producing cows individually. For example, a dairyman may group feed the grain ration at the rate of 10 pounds per cow per day. As listed in table 6, this amount of grain should meet the energy needs of cows producing up to 30 pounds of milk per day. A cow producing 75 pounds of milk per day would require an additional 20 pounds of grain per day (1 pound of grain to 2.5 pounds of milk), which could be fed in the milking parlor.

Formulating the Grain Ration

The actual formulation of a grain ration to a specific protein percent is discussed in FS583 entitled "Supplying Protein for Milk Production." Examples of typical grain rations containing different levels of protein are presented in table 7.

Economics of Grain Ration Ingredients

Homegrown grains are the primary energy sources available to dairymen. Since the primary purpose of grains is to furnish energy, it may be advantageous to substitute grains if the comparative prices are favorable. For example, corn priced at $1.30 per bushel or 2.3 cents per pound ($1.30÷56 pounds per bushel) would cost 2.9 cents per therm (2.3/lb.÷.80 therm/lb.=2.9c/therm). Barley priced at $1.23 per bushel or 2.6 cents per pound would cost 3.20c per therm. Even though barley is slightly higher in protein than is corn, it may be economically advantageous to feed the corn and sell the barley if a dairyman has a choice.

Usually, the cost of a grain ration may be reduced by substituting urea for the more expensive plant protein. For further information on feeding urea, ask for FS 406 entitled "Urea for Dairy Cattle."

Table 7. Examples of dairy grain mixtures.*

Feed ingredients	Crude protein % in grain mixture											
	12	12	12	12	15	15	15	15	18	18	18	18
	% ingredients to use											
Ear corn	58	------	------	------	52.5	------	------	------	46.5	------	------	------
Shelled corn	------	59.5	62.5	65.5	------	59.5	58.5	50	------	48.5	54	26
Oats or barley†	30	31	34	------	27	22	30	------	24	24	25	13
Wheat‡	------	------	------	25	------	------	------	32	------	------	------	37
Urea (281%)	------	------	1	------	------	------	1	------	------	------	1	------
Soybean oil meal (44%)	9.5	7	------	7	18	16	8	15.5	27.0	25	17.5	21.5
Mineral supplement	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Iodized trace mineral salt	1	1	1	1	1	1	1	1	1	1	1	1
Therm of NE per pound grain	75	.78	.76	.78	.76	.78	.77	.79	.76	.79	.77	.79

*To insure adequate amounts of vitamins, 3,000 to 4,000 IU of vitamin A and 300 to 400 IU of vitamin D should be supplied per pound of grain mixture.

†Oats and barley or the combination of the two should not make up over 50% of the ration, and any combination of oats, barley or wheat should not exceed 50%.

‡Wheat should not make up over 50% of the ration and must be rolled or cracked but not finely ground.

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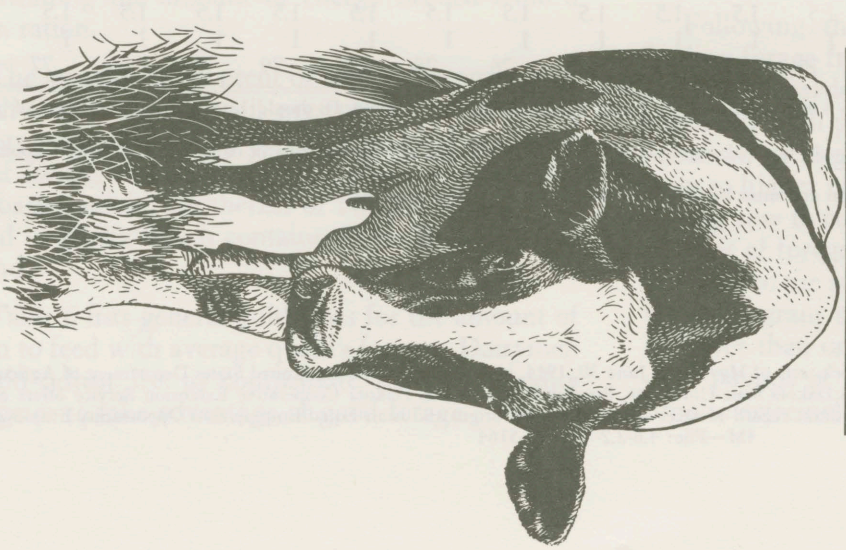

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